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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/964,910	09/27/2001	Kiyoshi Yamaura	112857-301	3249

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EXAMINER	
YUAN, DAH WEI D	

ART UNIT	PAPER NUMBER
1745	

DATE MAILED: 03/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/964,910	YAMAURA ET AL.	
	Examiner	Art Unit	
	Dah-Wei D. Yuan	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 January 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *8,10-14 and 16-32* is/are pending in the application.

4a) Of the above claim(s) *27-32* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *8,10-14 and 16-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 September 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

GAS DIFFUSION ELECTRODE AND FUEL CELL INCLUDING SAME

Examiner: Yuan S.N. 09/964,910 Art Unit: 1745 March 22, 2005

Detailed Action

1. The Applicant's Request for Reconsideration filed January 28, 2005 was received.

2. The text of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action issued on November 10, 2004.

Specification

3. The amendment filed on August 16, 2004 is objected to under 35 U.S.C. 132 because it introduces new matter into the disclosure. 35 U.S.C. 132 states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: ... wherein the gas diffusion electrode comprises a thickness of less than 5 μm" in claim 8; "... wherein at least one of the first electrode and the second electrode comprises a thickness of less than 5 μm" in claims 14 and 21.

Applicant is required to cancel the new matter in the reply to this Office Action.

Claim Rejections - 35 USC § 112

4. Claims 8,10-14,16-26 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The recitations "...wherein the gas diffusion electrode comprises a thickness of less

than 5 μm" in claim 8 and "...wherein at least one of the first electrode and the second electrode comprises a thickness of less than 5 μm" in claims 14 and 21 are not supported in the instant disclosure. The instant specification only discloses the fuel (oxygen) electrode of thickness ranging from about 2 to about 4 μm. If applicant believes said terms are fully defined, it is requested that applicant indicates column and line, and/or figure with number, in the specification. For the purpose of compact examination, the claims are interpreted as being directed to an electrode having a thickness of about 2 to less than 5 micrometers.

Claim Rejections - 35 USC § 103

5. Claims 8,10,14,16-18,20,21,26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fleckner et al. (US 6,589,682 B1) as evidenced by Oyama et al. (US 2003/0048057 A1).

With respect to claims 8,10, Fleckner et al. teach a fuel cell comprising two gas diffusion layers (100,102) (gas diffusion electrode), which comprises carbon nanotubes to distribute reactant gas over the catalyst sites. Fleckner et al. further teach the nanotubes can be processed by a variety of methods including vapor deposition techniques. One in-situ technique which can advantageously be used is chemical vapor deposition of various hydrocarbon compounds such as methane at controlled locations on a substrate using patterned catalytic islands. This combined synthesis and microfabrication technique allows a large number of ohmically contacted nanotube devices of controllable length to be placed on a single substrate. See Column 7, Lines 8-36; Column 9, Lines 32-46; Figures 6-8. It is well known that carbon nanotube is a fibrous carbon material as evidenced by Oyama et al. See Paragraph 4.

The disclosure of Fleckner et al. differs from Applicant's claims in that Fleckner et al. do not specifically disclose the thickness of the fibrous carbonaceous material. However, it would have been obvious to one of ordinary skill in the art to synthesize the nanotube for use as a gas diffusion electrode in a fuel cell to a thickness of about 2 to less than 5 micrometers, because Fleckner et al. teach the length of the nanotube is controllable by using the combined chemical vapor deposition and microfabrication technique.

With respect to claims 14,16, Fleckner et al. teach a fuel cell comprising a Nafion membrane (92) (a perfluorosulfonate ionomer) disposed between two gas diffusion electrodes (100,102). The gas diffusion electrodes further comprise carbon nanotubes. See Column 7, Lines 8-36; Figures 6-8.

With respect to claims 17,18, Fleckner et al. teach the fuel cell further comprising a Pt/carbon ink by mixing 20 wt.% platinum on Vulcan XC-72R carbon with Nafion solution. See Column 8, Lines 39-58.

With respect to claim 20, the fuel is supplied through conduits (41) to the gas diffusion electrode (56) on the fuel side of the fuel cell whereas oxygen is supplied through conduits (43) to the gas diffusion electrode (54) on the oxidant side of the fuel cell. See Figure 2, Column 5, Lines 40-67.

With respect to claim 21, Fleckner et al. teach a fuel cell comprising a Nafion membrane (92) (a perfluorosulfonate ionomer) and two gas diffusion electrodes (100,102). The gas diffusion electrodes further comprise carbon nanotubes. See Column 7, Lines 8-36; Figures 6-8.

With respect to claim 26, Fleckner et al. teach the fuel cell further comprising a Pt/carbon ink by mixing 20 wt.% platinum on Vulcan XC-72R carbon with Nafion solution. See Column 8, Lines 39-58.

6. Claims 8,11,14,16,21,23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hager et al. (US 6,013,371) in view of Fischer et al. (US 5,861,222) as evidenced by Kordesch et al. (Fuel Cells and Their Applications, VCH Publishers, Inc.)

With respect to claims 8,11, Hager et al. teach the use of vapor grown carbon fiber (VGCF) to fabricate separators and electrodes (gas diffusion electrodes) in a fuel cell. See Column 3, Line 62 to Column 4, Line 5; Column 9, Line 56 to Column 10, Line 6; Column 12, Lines 11-16.

However, Hager et al. do not teach the thickness of the gas diffusion electrode for use in a fuel cell. Fischer et al. teach the optimum thickness of the gas diffusion electrode is in a range of 5 to 100 μm. See Column 4, Lines 51-51; Column 5, Lines 56-60. Therefore, it would have been obvious to one of ordinary skill in the art to use the vapor grown carbon fiber of Hager as the gas diffusion electrode having a thickness of 5 to 100 μm, because Fischer et al. teach the optimum thickness of the gas diffusion layer in a fuel cell is in a range of 5 to 100 μm. When a composition with a touching or overlapping range is found in the prior art, this is considered sufficient to support a holding of obviousness. In re Malagari, 182 USPQ 549.

With respect to claims 14,16,21,23, Hager et al. teach the electrodes in a fuel cell can be made of vapor grown carbon fiber (VGCF) material. The VGCF material from Applied

Sciences, Inc of Cedarville, OH is a discontinuous highly graphitic fiber with an unique annular morphology. The fuel cell inherently comprises proton conducting material (electrolyte) sandwiched between an anode and a cathode as evidenced by Kordesch et al. See pages 51-53. A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. In re Robertson, 49 USPQ2d 1949 (1999).

7. Claims 12,13,19,22,24,25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fleckner et al. as applied to claims 8,10,14,16-18,20,21,26 above, and further in view of Hager et al. (US 6,013,371).

With respect to claim 12, Fleckner et al. disclose gas diffusion electrodes comprising carbon nanotube material as described above in Paragraph 6. However, Fleckner et al. do not teach the fibrous carbonaceous material comprising a mixture of carbon nanotubes and vapor grown carbon fibers. Hager et al. teach the addition of vapor grown carbon fibers can enhance the mechanical performance of the resulting carbon–carbon composite. See Column 3, Line 62 to Column 4, Line 5. Therefore, it would have been obvious to one of ordinary skill in the art to use of the mixture of carbon nanotube and vapor grown carbon fibers on the gas diffusion electrode of Fleckner et al., because Hager et al. teach the addition of VGCF can improve mechanical performance of the components.

With respect to claim 22, Fleckner et al. disclose a fuel cell comprising a proton conductor disposed between a first electrode and a second electrode wherein both electrodes

comprise a carbon nanotube material as described above in paragraph 9. However, Fleckner et al. do not teach the fibrous carbonaceous material comprising a mixture of carbon nanotubes and vapor grown carbon fibers. Hager et al. teach the addition of vapor grown carbon fibers can enhance the mechanical performance of resulting carbon–carbon composite. See Column 3, Line 62 to Column 4, Line 5. Therefore, it would have been obvious to one of ordinary skill in the art to use of the mixture of carbon nanotube and vapor grown carbon fibers on the gas diffusion electrode of Fleckner et al., because Hager et al. teach the addition of VGCF can improve mechanical performance of the components.

With respect to claims 13,19,24,25, Fleckner et al. and Hager et al. disclose applicant's invention essentially as claimed, with the exception that the ratio between the carbon nanotube and the vapor grown carbon fibers in the mixture is not discussed. However, Hager et al. recognize the incorporation of vapor grown carbon fibers into the composite can provide a reinforcing effect on the mechanical property of the material. See Column 3, Lines 8-12; Column 3, Line 62 to Column 4, Line 5. Therefore, it would have been within the skill of the ordinary artisan to adjust the relative amounts of carbon nanotube and vapor grown carbon fiber in the composite depending on the strength requirement of the composite electrode in the fuel cell. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art.* In re Boesch, CCPA 1980, 617 F.2d 272, 205 USPQ215.

Response to Arguments

8. Applicant's arguments filed on January 28, 2005 have been fully considered but they are not persuasive.

Applicant's principle arguments are

(a) As long as the specification discloses at least one method for making and using the claimed invention that bears a reasonable correlation to the entire scope of the claim, then the enablement requirement of § 112 is satisfied;

(b) Applicants have discovered that the fuel electrode and oxygen electrode are not required to be independent film, and thus, are not required to exhibit mechanical strength;

(c) Fleckner doe not disclose or suggest that the gas diffusion electrode composed of a carbonaceous material can be directly formed on the proton conductor material, such as an electrolyte film;

(d) Fischer teaches away from the claimed invention that the thickness of the gas diffusion electrode is less than 5 μm.

In response to Applicant's arguments, please consider the following comments.

(a) The instant discloses the fuel electrode and the oxygen electrode are not required to exhibit mechanical strength and may be of an extremely thin thickness of ranging from about 2 to about 4 μm. Applicant consequently reports the advantage of such gas diffusion electrode for use in a fuel cell. Nevertheless, the disclosure provides no teaching or example to demonstrate if the thickness of the electrode can be fabricated of a thickness less than 2 μm. The standard for

determining whether the specification meets the enablement requirement is to answer the question; is the experimentation needed to practice the invention undue or unreasonable? The instant disclosure teaches the use of spraying and dripping methods, whereas the carbonaceous material is dispersed in a liquid medium. It is known in the art that suspension may coagulate or flocculate because of interparticle forces, agglomerate structure and consistency of the processing system. Many processing variables, such as surfactant, viscosity and pH, would play important roles in determining the characteristics of the resulting gas diffusion electrode films. The lack of any specific teachings and embodiments makes it impractical to assess the probability of making thin gas diffusion electrode, i.e., less than 2 μm, without undue experimentation. It is, therefore, concluded that the specification at the time of the application was filed, would not have taught one skilled in the art how to make and/or use the full scope of the claimed invention without undue experimentation.

(b) Applicant is reminded that the limitation in the instant specification cannot read into the claim. The fact that fuel electrode and/or oxygen electrode do not have to be handled separately is not recited in the independent claims, thereby the rejection under 35 U.S.C. 103(a) as being unpatentable over Fleckner et al. as described above are maintained;

(c) the claimed novelty is not stated in the independent claims, and thus Fleckner reference meets all the limitations of the claims as described above;

(d) Examiner agrees with the Applicant that Fischer teaches the optimum thickness of the gas diffusion electrode is in a range of 5 to 100 μm. However, the unpatentable rejections are

based on the touching of ranges, i.e., less than 5 μm and 5 to 100 μm. See In re Malagari, 182 USPQ 549.

Conclusion

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dah-Wei D. Yuan whose telephone number is (571) 272-1295. The examiner can normally be reached on Monday-Friday (8:00-5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan, can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dah-Wei D. Yuan
March 23, 2005